Supplementary instructions

delta® Solenoid Metering Pump
Control Module delta®

Target group for these supplementary instructions: trained and qualified personnel

Three sets of operating instructions are required for the safe, correct and proper operation of the metering pumps: These supplementary instructions, the "General operating instructionsProMinent® solenoid metering pumps" and the "Operating instructions for the delta® solenoid metering pump with regulated solenoid drive optoDrive®". These are only valid when read together.

Please carefully read these operating instructions before use! · Do not discard!
The operator shall be liable for any damage caused by installation or operating errors!
Technical changes reserved.

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General non-discriminatory approach

In order to make it easier to read, this document uses the male form in grammatical structures but with an implied neutral sense. It is aimed equally at both men and women. We kindly ask female readers for their understanding in this simplification of the text.

Supplementary information

Please read the supplementary information in its entirety.

The following are highlighted separately in the document:

- Enumerated lists

→ Instructions

⇨ Outcome of the instructions

Information

This provides important information relating to the correct operation of the device or is intended to make your work easier.

Safety information

The safety information includes detailed descriptions of the hazardous situation.

Table of contents

1 Introduction

These operating instructions describe the technical data and functions of the control module delta®.

1.1 Safety and responsibility

1.1.1 General Safety Information

WARNING!
Live parts!
Possible consequence: Fatal or very serious injuries

- Measure: Disconnect the mains power supply prior to opening the housing
- De-energise damaged, defective or manipulated units by disconnecting the mains plug

WARNING!
Unauthorised access!
Possible consequence: Fatal or very serious injuries

- Measure: Ensure that there can be no unauthorised access to the unit

WARNING!
Operating errors!
Possible consequence: Fatal or very serious injuries

- The unit should only be operated by adequately qualified and technically expert personnel
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, measuring water pumps ...
- The operator is responsible for ensuring that personnel are qualified

CAUTION!
Electronic malfunctions
Possible consequence: Material damage to destruction of the unit

- The mains connection cable and data cable should not be laid together with cables that are prone to interference
- Measure: Take appropriate interference suppression measures

NOTICE!

Correct and proper use

Damage to the product or its surroundings

- The unit is not intended to measure or regulate gaseous or solid media
- The unit may only be used in accordance with the technical details and specifications provided in these operating instructions and in the operating instructions for the individual components

NOTICE!

Correct sensor operation / Run-in time

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor
- Please read the operating instructions for the sensor

NOTICE!

Correct sensor operation

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- Check and calibrate the sensor regularly

NOTICE!

Compensation of control deviations

Damage to the product or its surroundings

- This controller cannot be used in control circuits which require rapid compensation (< 30 s)

1.1.2 Specific safety instructions for the control module delta®

WARNING!

Emergency stop switch

Possible consequence: Fatal or very serious injuries

An emergency stop switch on the complete system. This should enable the complete system to be switched off in event of an emergency in such a way that the complete system is stopped in a safe condition.

WARNING!

- Hazardous substances
- Danger resulting from contact, breathing in or other contaminations with / from substances or media
- Observe the safety data sheet of the substances / media used
- The system operator must ensure that these safety data sheets are available and that they are kept up to date

WARNING!

- Unexpected starting after a failure, malfunction of the controller / power supply or as an action wanted due to a control process
- Danger due to unexpected actions of the system
- In event of a failure / malfunction of the controller or power supply, the measuring / control station must be disconnected from the power supply. For further information, read the operating instructions of the devices and sensors used

NOTICE!

- Secure the measuring / control station against unauthorised access
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, sample water pumps ...
- Observe the resistance of the wetted materials for all modules (see also, e.g. also the ProMinent resistance list in the product equipment catalogue or at www.prominent.com)
- Protect the measuring / control station against direct sunlight and other UV sources
- Observe the basic rules for ergonomic principles

1.1.3 Correct and proper use

NOTICE!

Compensation for control deviations

Damage to the product or its surroundings

- The controller can be used in processes, which require compensation of > 30 seconds

NOTICE!

Correct and proper use

The unit is intended to measure and regulate liquid media. The marking of the measured variables is located on the controller and is absolutely binding.

The unit may only be used in accordance with the technical details and specifications provided in this operating manual and in the operating manuals for the individual components (such as, for example, sensors, fittings, calibration devices, metering pumps etc.).

Any other uses or modifications are prohibited.

2 Functional description

Brief functional description

The control module delta® expands the delta® pump series to include measurement dependent metering pumps. The control module delta®has an active 4-20 mA input for combination with the measuring transducers pHV1, RHV1 or the chlorine sensor CLE-3mA. The control module delta® has PID control characteristics so that the delta® solenoid metering pump can be optimally matched to process requirements. If a two-sided control is required, a second pump can be controlled via the optional pacing relay.

For the *[controlled pump]* operating mode, the control module delta® must be connected to the DulcoFlow® DFMa ultrasonic flow meter. Both devices are connected by the 4 ... 20 mA interface. The DulcoFlow® DFMa ultrasonic flow meter must be set to *[controlled pump]* operating mode; refer to the operating instructions of the DulcoFlow® DFMa ultrasonic flow meter.

Table of measured variables: Assignment of the measured variable to the measuring input of the control module delta®

Measured variable	mA input	Part no. of the measuring transducer
Chlorine	X	
pH	X*	809126
Redox	X*	809127
Volume	X**	
Flow	X**	

***with measuring transducer**

**** with a flow meter**

2.1 Application example control module delta®

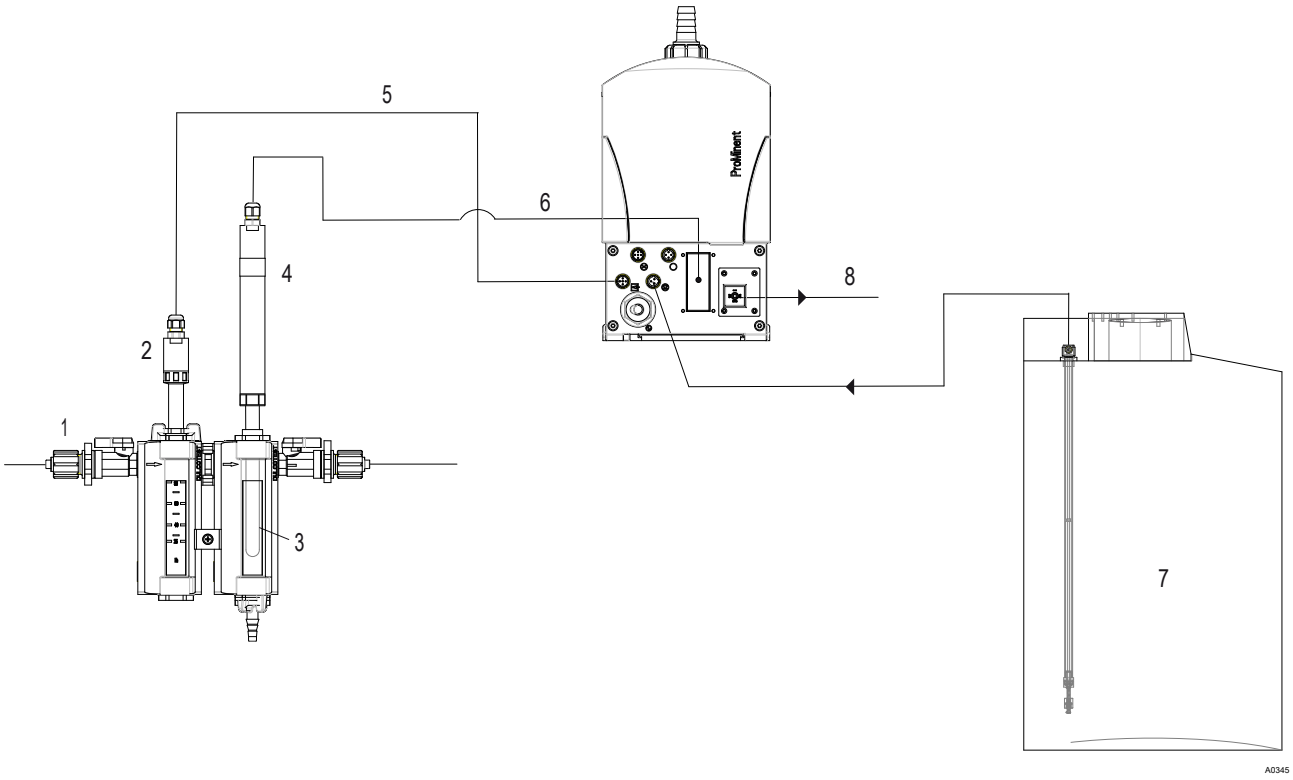

Fig. 1: Application example of pH or redox system for one-sided control

1. Sample water feed (30 - 60 l/h)
2. Flow sensor (part of DGMA)
3. pH sensor (PHEP 112SE) or redox sensor (e.g. RHEP-Pt-SE)
4. pH measuring transducer (pHV1 / 809126) or redox measuring transducer (RHV1 / 809127)
5. Universal control cable (e.g. 1001300)
6. External cable (2-pole / e.g. 707702)
7. Tank with two-stage lance
8. Relay cable (optional part of the delta® solenoid metering pump)

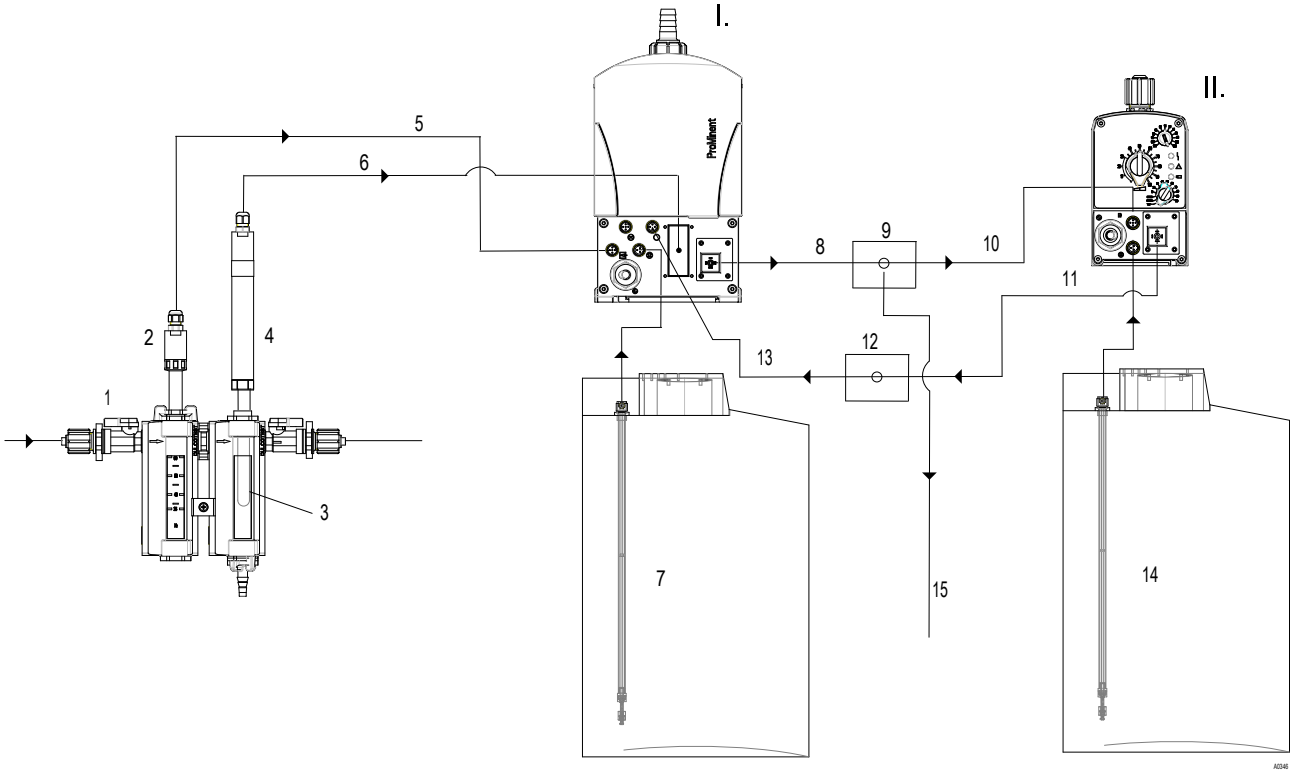

Fig. 2: Application example of pH or redox system for two-sided control

I. First pump delta® with control module delta®
II. Second pump e.g. Beta®
1. Sample water feed (30 - 60 l/h)
2. Flow sensor (part of DGMA)
3. pH sensor (e.g. PHEP 112SE) or redox sensor (e.g. RHEP-Pt-SE)
4. pH measuring transducer (pHV1 / 809126) or redox measuring transducer (RHV1 / 809127)
5. Universal control cable (e.g. 1001300)
6. External cable (2-pole / e.g. 707702)
7. Tank with two-stage lance
8. Optional relay cable (part of the delta® solenoid metering pump)
9. Junction box 1
10. External cable (2-pole / e.g. 707702)
11. Relay cable (3-conductor, part of the external pump)
12. Junction box 2
13. Diaphragm rupture cable
14. Suction lance
15. Collective alarm

2.2 Connection in controlled pump operation

Connect the output of the flow meter (4 ... 20 mA round plug) to the input of the delta®control module (4 ... 20 mA).

2.3 Electrical interfaces

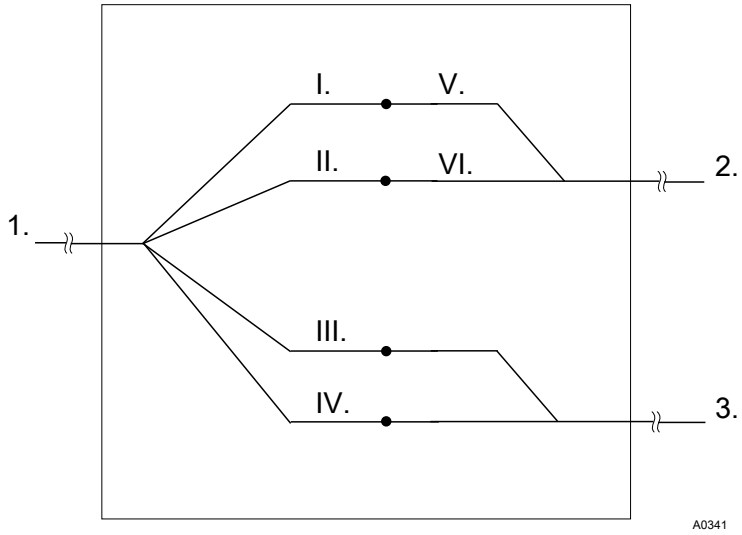

Fig. 3: Connector box 1 (IP 65)

1. Relay cable, 4 pin
2. External cable for the second pump
3. Fault indicating relay = external group alarm (max. load 24 V / 100 mA)

I. White (pacing relay)
II Brown (pacing relay)
III. Yellow (fault indicating relay)
IV. Green (fault indicating relay)
V. White
VI. Brown

Connect the external pump using a 4 pin relay cable

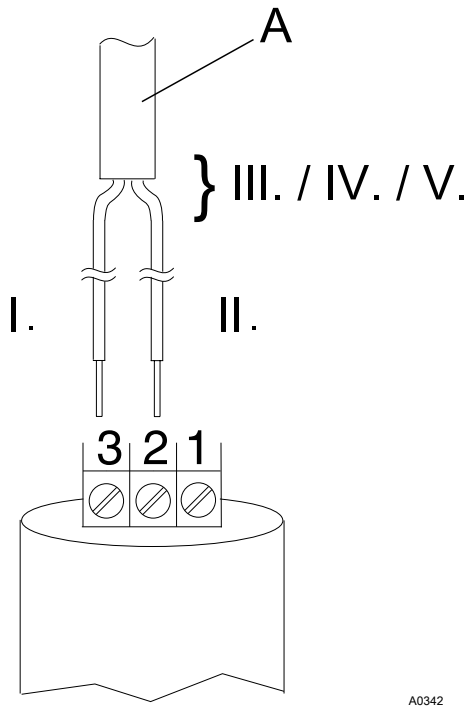

Fig. 4: Connection of the flow sensor

A. 5 pin universal cable
I. Black
II. Brown
III. Blue (remains inactive)
IV. Grey (remains inactive)
V. White (remains inactive)

Functional description: As soon as the flow rate drops below a set threshold, the contact is opened and the delta® solenoid metering pump switches to *'PAUSE'*.

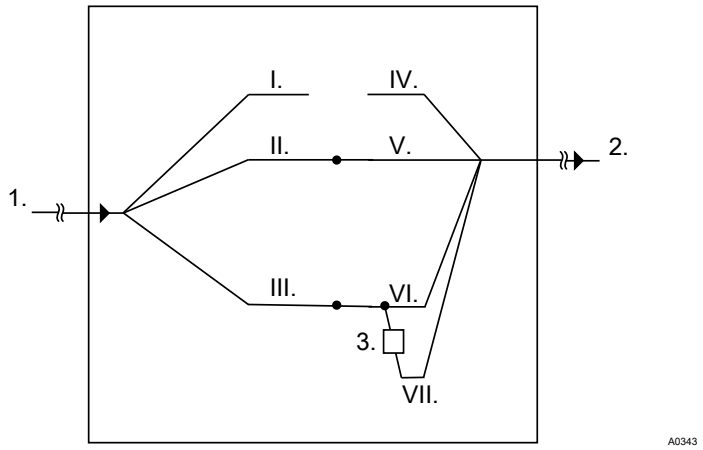

Fig. 5: Connector box 2 (IP 65)

1. Relay cable, 3 pin beta
2. Delta diaphragm rupture cable
3. Resistance 300 Ω

I. White (open)
II. Green (NC)
III. Brown (C)
IV. White (open)
V. Blue (signal)
VI. Black (ground)
VII. Brown (5 V)

Connecting the alarm relay of the external pump to the input of the diaphragm rupture indicator of the delta® solenoid metering pump. As soon as the external pump reports a fault, this fault is passed on to the delta® via the input of the diaphragm rupture indicator. The delta® solenoid metering pump stops and issues a group alarm.

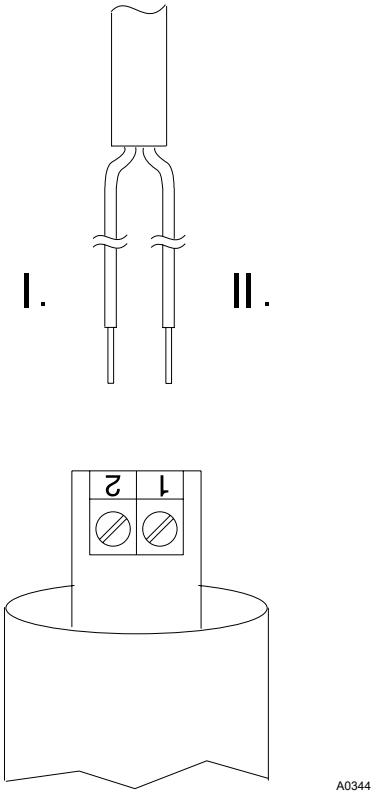

Fig. 6: Connection of the sensor or measuring transducer; 2-conductor external cable

I. White
II. Brown

5-conductor universal cable

However, when using a 5-conductor universal cable: I. black + brown, bridged; and II. white

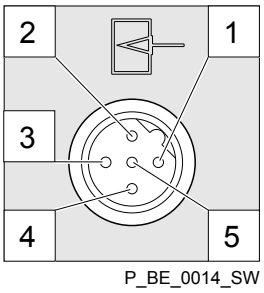

Fig. 7: Control module assignments

1 free
2 Supply voltage approx. 25.5 volt
3 GND
4 Current input
5 free

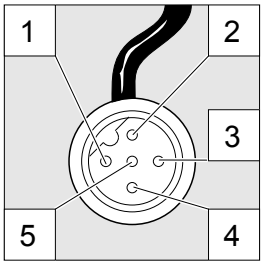

Fig. 8: Assignment on cable / 2-conductor external cable

1 free
2 Brown / supply voltage approx. 25.5 volt
3 free
4 White / current input
5 free

3 Installation

NOTICE!

Mounting position and conditions

- Ensure that there is unimpeded access for operation
- Secure, low-vibration fixing
- Avoid direct sunlight
- Permissible ambient temperature at fixing position: -10 ... + 45 °C at max. 95% relative air humidity (non-condensing)

NOTICE!

Operating instructions for all components used

Possibility of material damage due to incorrect installation.

When installing the system also observe the operating instructions for all components used.

Read-off and operating position

- *Install the device at a favourable position for reading-off and operating (preferably at eye level)*

The control module delta® is fully integrated in the delta® solenoid metering pump and does not require separate installation.

3.1 Installation (hydraulic)

CAUTION!

- Observe the maximum permissible operating parameter for the entire installation of the measuring / control station (e.g. pressure, temperature, flow)
- In the process, observe the lowest maximum permissible operating parameter of the parts of the measuring / control and the sensors installed (see their operating instructions)
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, sample water pumps ...
- Observe the flow direction of the measured water.
- One pressure reducer must be installed.
- Danger resulting from media under pressure.
- Before working with hydraulic parts of the measuring / control station, this must be depressurised in a controlled manner via the sampling cock.
- Wear protective goggles

Fittings

The bypass fitting (flow gauge) used depends particularly on the measured water, in some cases also from the measured variable or or the combination of the measured variables. The type DGMA with flow controller is always used for all clear water types and the type DLG III for contaminated water is also used for upstream flow controlling.

Hydraulic connection, pipework

With the DGMa, the hydraulic connection of the measured water is carried out using an 8 x 5 mm hose connection. A shut-off ball valve is installed before and after the bypass fitting. The optionally available measuring water filter is installed before the bypass fitting. Each of the bypass fittings have a mounted sampling cock.

3.2 Hydraulic test run after installation

A hydraulic test run of the measuring / control station is necessary after successful installation.

- The sampling cock must be closed! Otherwise measured water will escape
- Check all screw connections before the initial commissioning
- Open the shut-off ball valve on the inlet and outlet ends.
- The system must now be hydraulically tight. No fluid must leak out.

If fluid should leak out, the reason for this must be determined and eliminated.

3.2.1 Set the flow meter switching point

1. For testing, reduce the flow - the delta® Solenoid metering pump must indicate *'Pause'*
2. Check the screw connection for leaks.

The flow gauge DGMa:

Goal: Reduction in flow should switch - *'Pause'* on the delta® solenoid metering pump when the inlet is closed

1. Set the flow using the ball valve.
2. Set value: 40 l/h
3. Test value: 30 to 60 l/h (read-off from the top edge of the float)
4. Loosen the flow gauge.
5. Push the flow gauge upwards in the rail until the delta® Solenoid metering pump switches to *'Pause'* .
6. Push the flow gauge down far enough until *'Pause'* on the delta® solenoid metering pump has just cancelled.
7. Fasten the flow gauge.
8. For testing, reduce the flow

   ⇨ - the delta® Solenoid metering pump must switch to *'Pause'* .

3.3 Commissioning sensors

WARNING!

- Hazardous substances
- Danger resulting from contact, breathing in or other contaminations with / from substances or media
- Observe the safety data sheet of the substances / media used
- The system operator must ensure that these safety data sheets are available and that they are kept up to date

CAUTION!

- The sampling cock must be closed! Otherwise measured water will escape
- The measured water must be free of air bubbles to guarantee a reliable measurement and control! If air has to be carried along in the measuring water due to the process, the air must be discharged using a suitable technical method.
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, sample water pumps ...

Preparation

1. Retighten all screw connections and check for leaks.
2. Check the position of all shut-off valves. The position of the shut-off valves must guarantee that the measuring / control station is tight and the flow of the measured water is given.
3. Commission the measuring / control station

3.3.1 Run-in time

A run-in time must be observed for the chlorine sensor. Depending on the sensor, this may vary between 1 hour and 24 hours. For this purpose, the respective sensor must be located in the measured water to be measured and connected electrically. This measured water must already contain the measured variables in a quality and quantity sufficient for the process.

The running-in of the sensors is described in the operating instructions of the sensor.

3.4 Switching of inductive loads

If you connect an inductive load, i.e. a consumer which uses a coil (e.g. an alpha motorised pump), then you must protect your controller with a protective circuit. If in doubt, consult an electrical technician for advice.

The RC member protective circuit is a simple, but nevertheless very effective, circuit. This circuit is also referred to as a snubber or Boucherot member. It is primarily used to protect switching contacts.

When switching off, the connection in series of a resistor and capacitor means that the current can fade out in a damped oscillation.

Also when switching on, the resistor acts as a current limiter for the capacitor charging process. The RC member protective circuit is highly suited to AC voltage supplies.

The magnitude of the resistance R of the RC member is determined according to the following equation:

$R=U/I_L$

(U= Voltage divided by the load // I_L = load current)

Units: R = Ohm; U = Volt; I_L = Ampere; C = µF

The magnitude of the capacitor is determined using the following equation:

$C=k * I_L$

k=0,1...2 (dependent on the application).

Only use capacitors of class X2.

Units: R = Ohm; U = Volt; I_L = Ampere; C = µF

If consumers are connected which have a high starting current (e.g. plug-in, switched mains power supplies), then a means of limiting the starting current must be provided.

The switching-off process can be investigated and documented using an oscilloscope. The voltage peak at the switch contact depends on the selected RC combination.

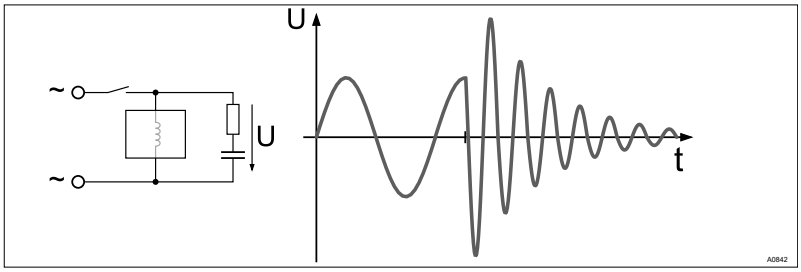

Fig. 9: Switching-off process shown on the oscillogram.

WARNING!

Mains voltage

Possible consequence: Fatal or very serious injuries

If mains voltage is connected to one of the terminals XR1-XR3 or XP, then no protective low voltage may be connected to any other of these terminals (SELV).

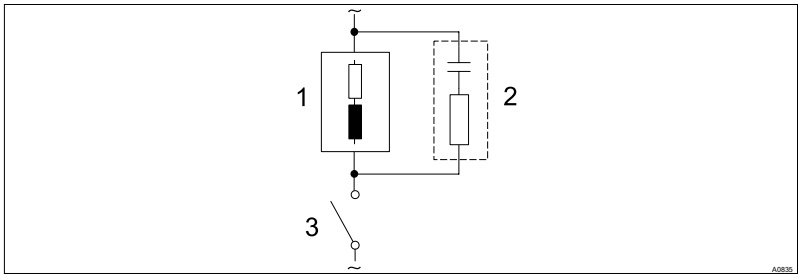

Fig. 10: RC protective circuit for the relay contacts

Typical AC current application with an inductive load:

- 1) Load (e.g. alpha motorised pump)
- 2) RC-protective circuit
  - Typical RC protective circuit at 230 V AC:
  - Capacitor *[0.22µF/X2]*
  - Resistor *[100 ohm / 1 W]* (Metal-oxide (pulse-resistant))
- 3) Relay contact (XR1, XR2, XR3)

4 Commissioning

WARNING!

Run-in time of sensors

This can result is hazardous incorrect metering

Take into consideration run-in times when commissioning

- Correct measuring and metering is only possible if the sensor is working perfectly
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor
- Please read the operating manual for the sensor

4.1 Initial Commissioning

The control module delta® has the same language settings as the control module delta® connected to the delta® solenoid metering pump.

4.1.1 Selecting the operating language

Setting the operating language is carried out via the setting menu of the connected delta® solenoid metering pump.

4.1.2 Selection of the Measured Variable and Measuring Range

WARNING!

Incorrect metering due to incorrect metering range

Possible consequence: Fatal or serious injuries

- **The measuring range of the sensor is essential for the measuring range!**
- If the assignment of the measuring range is modified, the settings must be checked in all menus
- If the assignment of the measuring range is changed, the sensor must be recalibrated

5 Operating diagram/ Display Symbols

Operation of the delta® solenoid metering pump with regulated solenoid drive optoDrive®

The delta® solenoid metering pump with regulated solenoid drive optoDrive® operating instructions are available for basic operation of the delta® solenoid metering pump. The control module delta® operating instructions describe the advanced operating options of the control module delta® used in conjunction with the delta® solenoid metering pump.

Access to the settings for the control module delta®

To gain access to the settings of the control module delta® you must stop the delta® solenoid metering pump using key . The symbols and Stop appear in the display. Only now do you have access to the settings for the control module delta®.

5.1 Overview of device / operating elements

> ***Contents of the LCD display***
> *The content of the LCD display can vary depending on the Identcode of the delta® solenoid metering pump.*

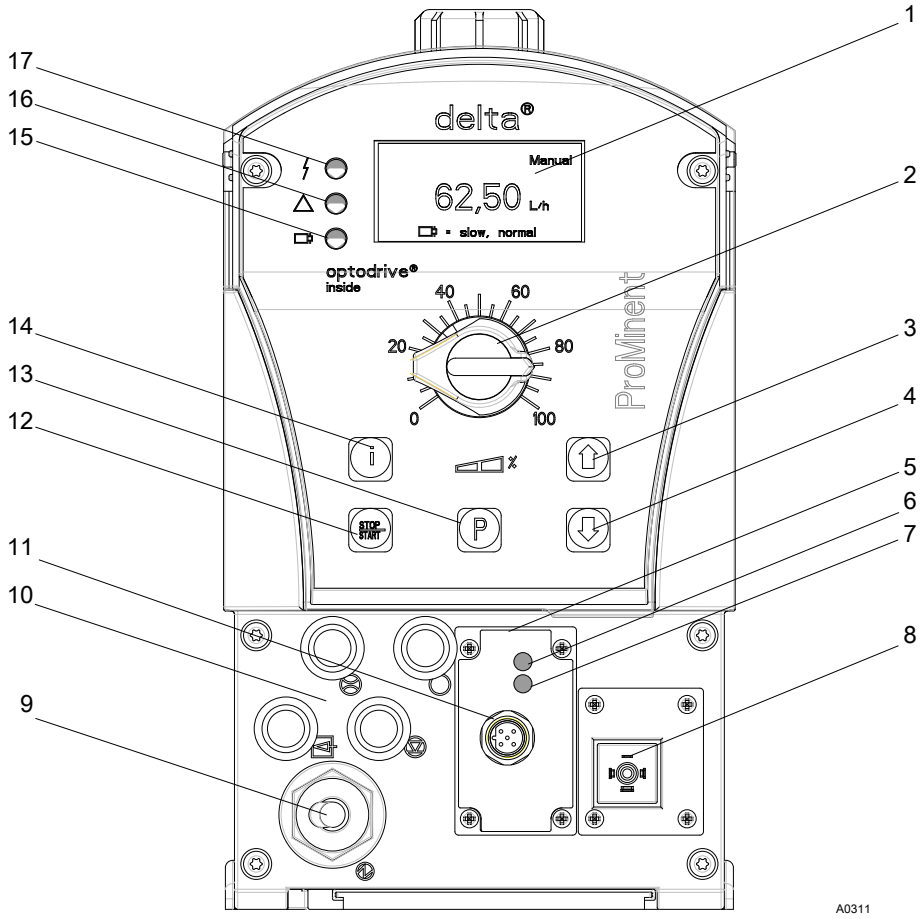

Fig. 11: Operating elements of the delta® solenoid metering pump

1 LCD display
2 Stroke length adjustment knob
3 UP key
4 DOWN key
5 Control module delta®
6 Device LED
7 Connecting LED
8 Relay insert (optional)
9 Mains power
10 Terminal for the additional functions
11 Sensor connection
12 STOP / START key
13 P key
14 i key
15 Operating indicator (green)
16 Warning indicator (yellow)
17 Fault indicator (red)

5.1.1 Key functions

Key	Operation	In continuous displays (Operation)	In setting mode (Settings)
STOP / START key 	briefly pressed (0.2 - 1 s)	stop pump start pump	stop pump start pump
P key 	briefly pressed (0.2 - 1 s)	start batch (only in operating mode "Batch")	Confirm entry - Jump to next menu option or in the continuous display
	2 s pressed	go to setting mode	----
	3 s pressed	----	Return *[ESCAPE]* to the continuous display
i key 	briefly pressed (0.2 - 1 s)	toggle between the continuous displays	----
	long pressed (> 1 s)	go to the second level of the continuous display	----
Arrow keys UP or DOWN  	individually pressed (until double arrows appear)	change directly adjustable variables	select another setting. change individual figure or number. at the upper end of a selection, effect similar to the ESC key
	simultaneously pressed	suction (in continuous display "stroke frequency")	----

5.2 Continuous display add-on, control module delta®

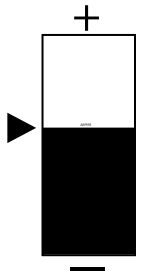

Fig. 12: Setpoint symbol (12x24 pixels)

In the main display, extra displays for the control module delta® can be inserted in addition to the delta® solenoid metering pump displays.

The control module delta® displays are the values for the setpoint and actual values of the control module delta®.

- I. Setpoint (of the control module delta®) in very large portrayal (12x24 pixels) in the selected unit (ppm, pH, l/h or mV)
- II. Actual value *[i]* (Input value for the control module delta®) in very large portrayal (12x24 pixels) in the selected unit (ppm, pH, l/h or mV)
- III. Existing continuous displays of the delta® solenoid metering pump

Format for the main displays:

- = Setpoint
- Chlorine: XXX.YY ppm
- pH: XX.YY pH
- Redox: XXX mV

Display: Only the measured value is displayed = Actual value

Display: Measured value with a in front of it = Setpoint

5.3 Secondary display control module delta®

Both the setpoint value and the current actual value of the control module delta® are displayed In the secondary display.

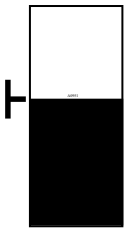

Fig. 13: Setpoint symbol (8x8 points)

- I. Setpoint (of the control module delta®) in the selected unit (ppm, pH, l/h or mV)
- II. Actual value *[i]* (input value of the control module delta®®) in the selected units (ppm, pH or mV)
- III. Current value (input value of the control module delta®) in xx.xx mA
- IV. Existing continuous displays of the delta® solenoid metering pump

Format for the secondary displays

- (= Setpoint):
- Chlorine: XXX.YY ppm
- pH: XX.YY pH
- Redox: XXX mV
- Flow rate: XX.XX l/h

Display: Only the measured value is displayed = Actual value

Display: Measured value with a in front of it = Setpoint

5.4 Activate/deactivate control module delta®

The following menu is used to place the delta® solenoid metering pump in control module delta® operating mode.

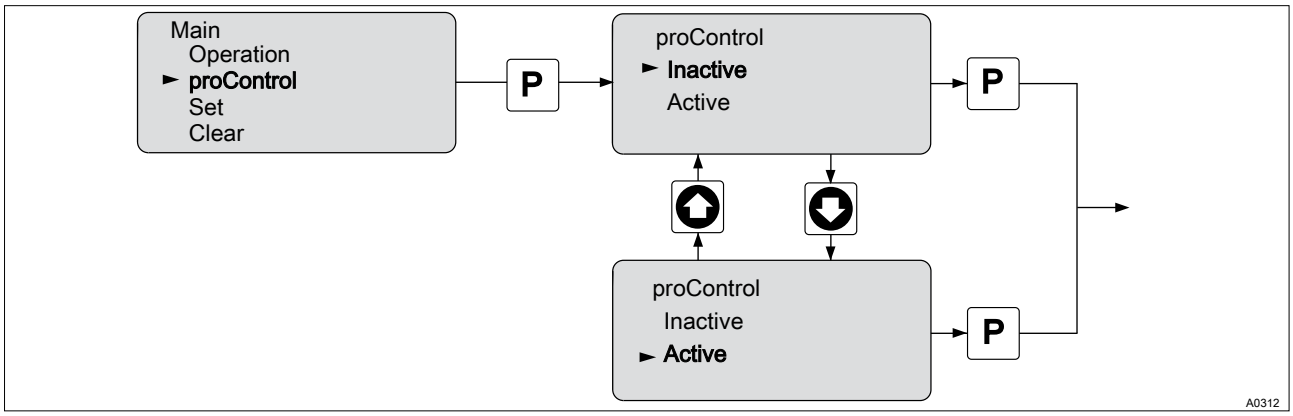

Fig. 14: Activate/deactivate control module delta®

If the control module delta® is *'switched'* to active then regulation or control of the delta® solenoid metering pump is carried out by the control module delta®. This independent of which operating mode the delta® solenoid metering pump was previously in. If the control module delta® is switched to *'inactive'*, then the delta® solenoid metering pump returns to its original operating status.

In the inactive state, no error or warning messages are transferred to the delta® solenoid metering pump.

If the control module delta® was *'switched'* to active then the symbol appears in the operating indicator of the delta® solenoid metering pump to signal that the control module delta® is working in active mode. At the same time, the *'Connection LED'* switches to green in control mode.

The *[display text]* for the operating mode displays the text ***'↑ increase'*** or ***'↓ decrease'***.

In the *[controlled pump]* operating mode, *[flow]* is shown.

5.5 Selection of the Measured Variable and Measuring Range

The delta® control module has a 4 - 20 mA input. A sensor can be connected to this input. The control parameters, the menus and the continuous display are sensor-specific.

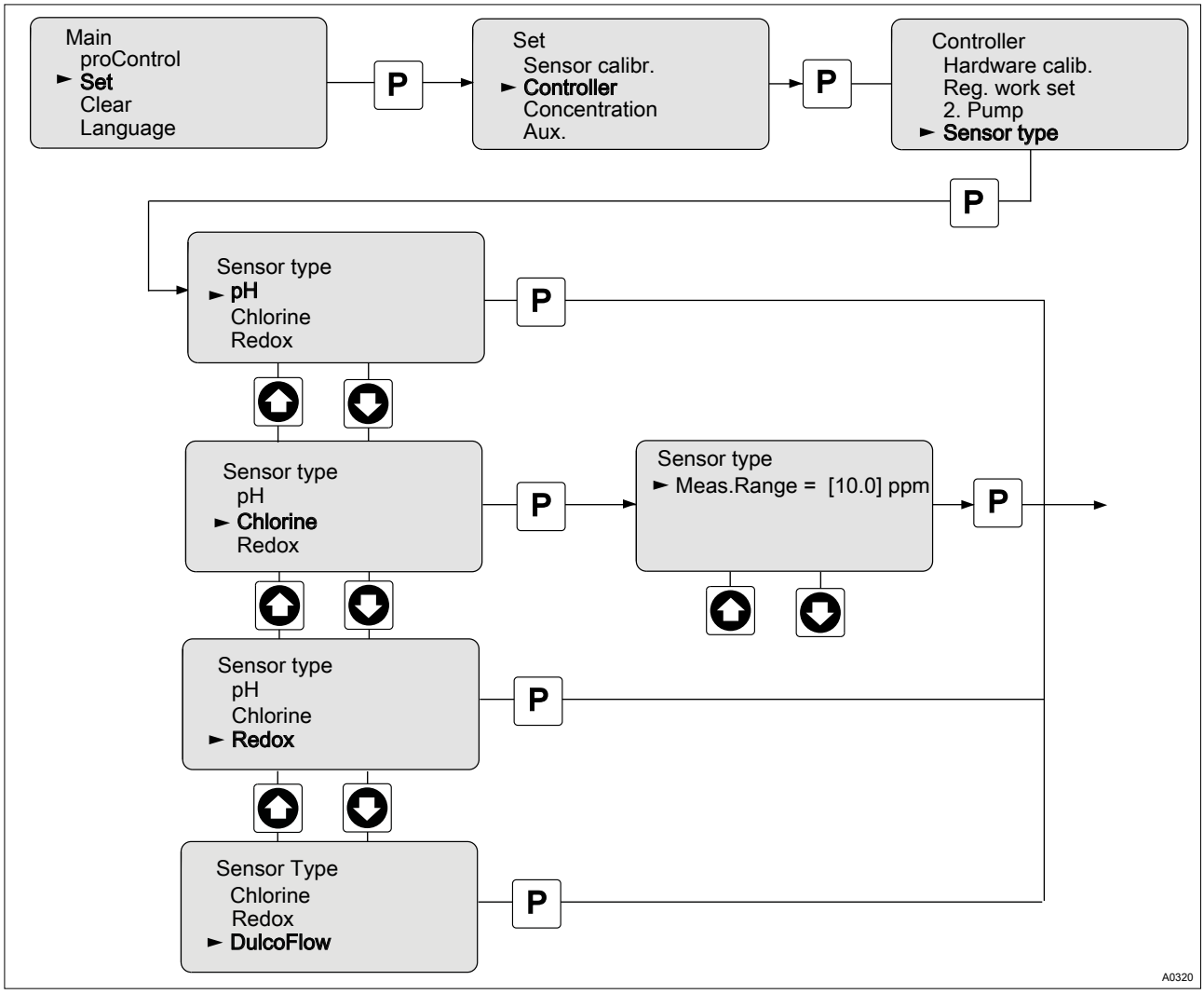

Fig. 15: Selection of the Measured Variable and Measuring Range

You can select the appropriate sensor under the menu option *'Sensor type'*. You can also select the different variants or measuring ranges of the sensors in this menu option.

Sensors	Types
Redox	Only one sensor variant, is operated with the "RhV1" measuring transducer. ■ 1000 mV ➡ 20 mA ■ 0 mV ➡ 4 mA
Chlorine	■ Measuring range from 0 ... 20 ppm
pH	Only one sensor variant, is operated with the "pHV1" measuring transducer. ■ -500 mV ~ pH 0 ➡ 20 mA ■ 500 mV ~ pH 14 ➡ 4 mA
DulcoFlow®	The *[controlled pump]* operating mode only works together with the DulcoFlow® flow meter. It is possible to select between different operating modes: ■ *[Controlled pump]*, when the pump is operated in *[manual]* mode. – 0.01 ... 80.00 l/h ■ *[Volume metering]*, when the pump is operated in *[batch]* mode. – 0.01 ... 10.00 l/h

"Controlled pump" operating mode

In the [controlled pump] operating mode (volume metering), the minimum stroke frequency of the pump is 4 strokes; the metered quantity (volume) must always be set so that the pump requires ≧ 4 pump strokes for this quantity. Once metering of a quantity has started, this can be stopped with the [Start/Stop] key; volume metering is then stopped.

5.6 Setting the Limits

Hysteresis

Built-in hysteresis ensures that the control module delta® does not continuously switch between control and base load metering in the limit value range.

The hysteresis is approx 2 % of the measuring range:

– *(‘upper limit value’ minus ‘lower limit value’) * 2 %*

Valid limit values can be set for the control of each sensor type. The control is adjusted when a measured value is outside of the limit value. In this case, only basic load control is active.

If the measured value is outside of the limit value, a warning is emitted and the symbol ! is output to the status display of the delta® solenoid metering pump.

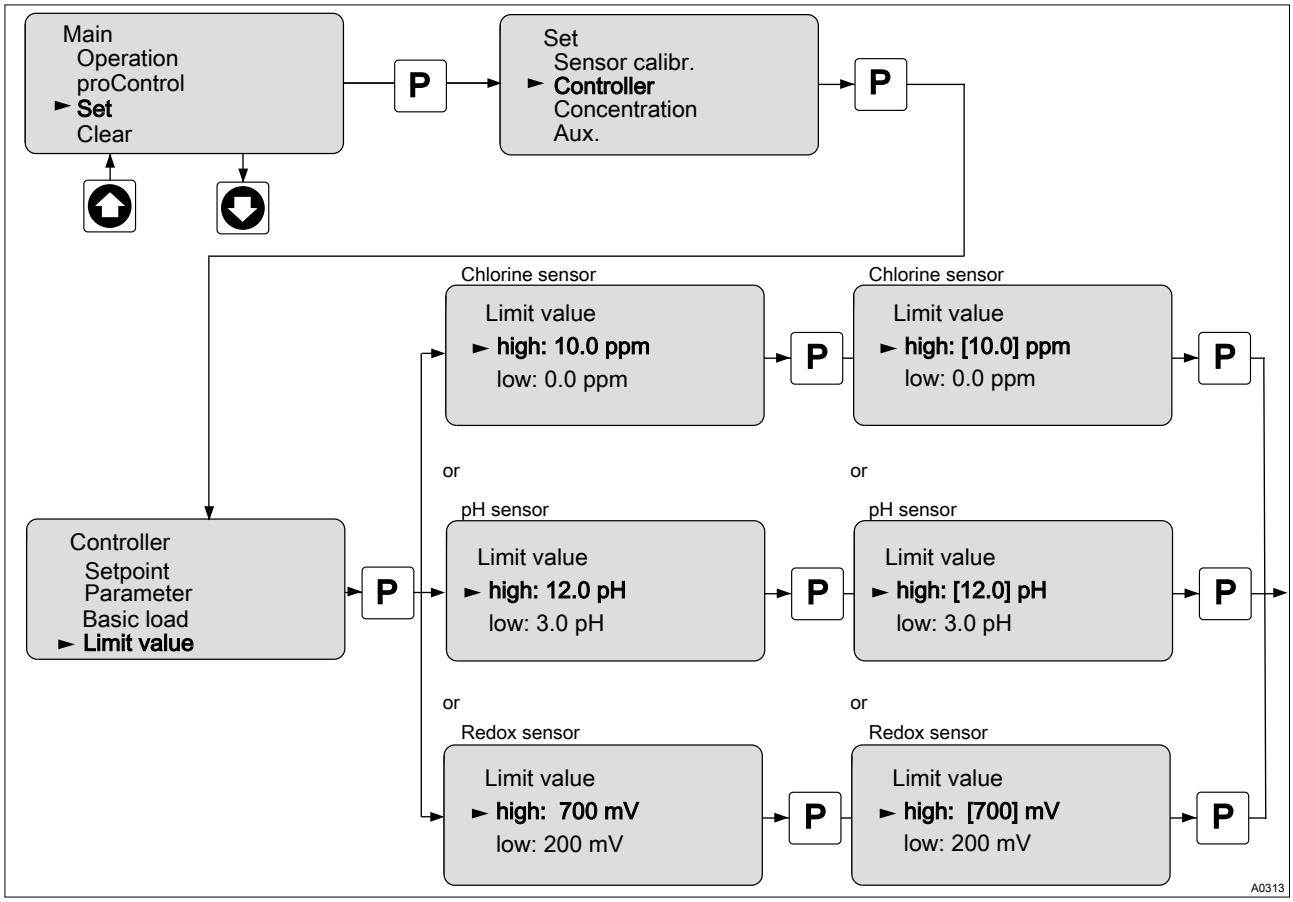

Fig. 16: Setting the Limits

Sensor	Factory setting		Settings
	upper	lower	
Chlorine	0 ppm	20 ppm	0 ppm to the maximum value of the sensor In steps of 0.1 ppm
pH	0 pH	14 pH	0 pH to 14 pH. In steps of 0.1 pH
Redox	0 mV	1000 mV	0 mV to 1000 mV. In steps of 1 mV
Flow	--	--	No limit values can be set for this.
Volume	--	--	

5.7 Setting the basic load

Basic load

It may be necessary to meter the feed chemical with a basic load.

You can switch the basic load control on or off using this menu. You switch the basic load on by entering a percentage proportion of the maximum set value.

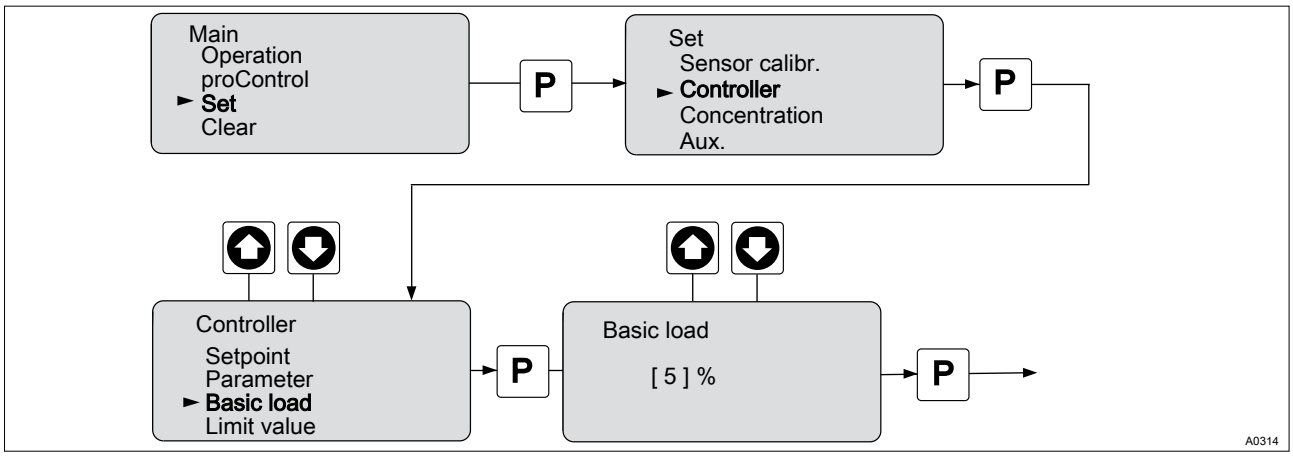

Fig. 17: Setting the basic load

Basic load	Settings
Setting values	0 % to 100 % in increments of 1 %. Start value of 0 %. 0 % = Basic load off.

5.8 Setpoint adjustment

The setpoint can be set from this menu. In the continuous display a ▮ is placed in front of the setpoint display value.

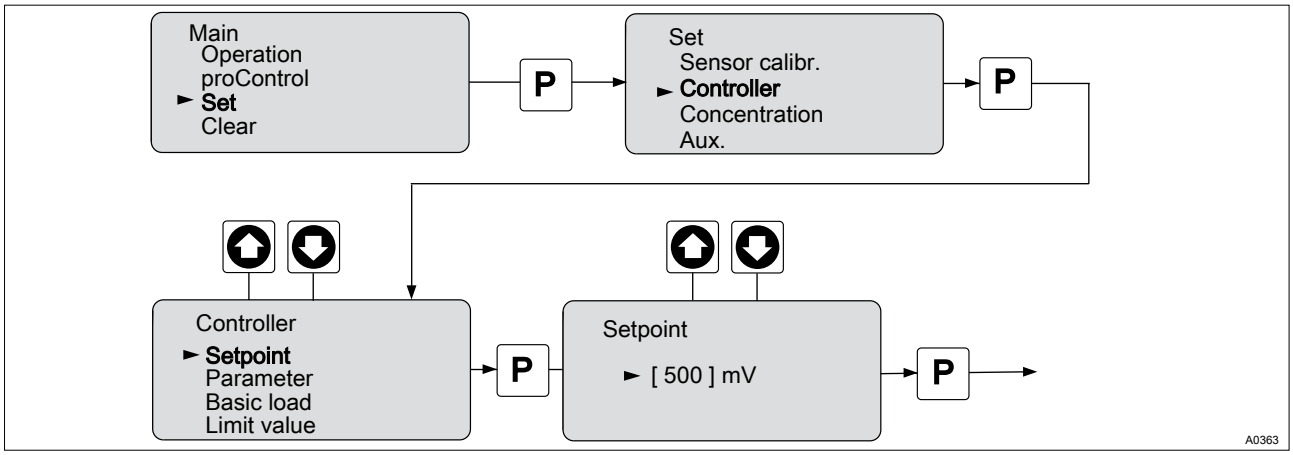

Fig. 18: Setpoint adjustment

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remark
mV	500 mV	1 mV	0 mV	999 mV	Redox
pH	7,00 pH	0,01 pH	0,00 pH	14,00 pH	
Chlorine	5.00 ppm	0.01 ppm	0 ppm	20 ppm	
The upper and lower value can only be set within the range of the set limit values, see *Chapter 5.6 'Setting the Limits' on page 25*. The values in the table show the maximum possible range.					

Settings for the "controlled pump" operating mode

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remark
l/h	0	10 ml/h	0.01 l/h	80.00 l/h	In *'Manual'* operating mode:
l	0	10 ml	0.01 l	10.00 l	In *'Batch'* operating mode:

5.9 Checkout time adjustment

Monitoring of the control path

The checkout time monitors the control path. The checkout time mechanism permits detection of possible defective sensors.

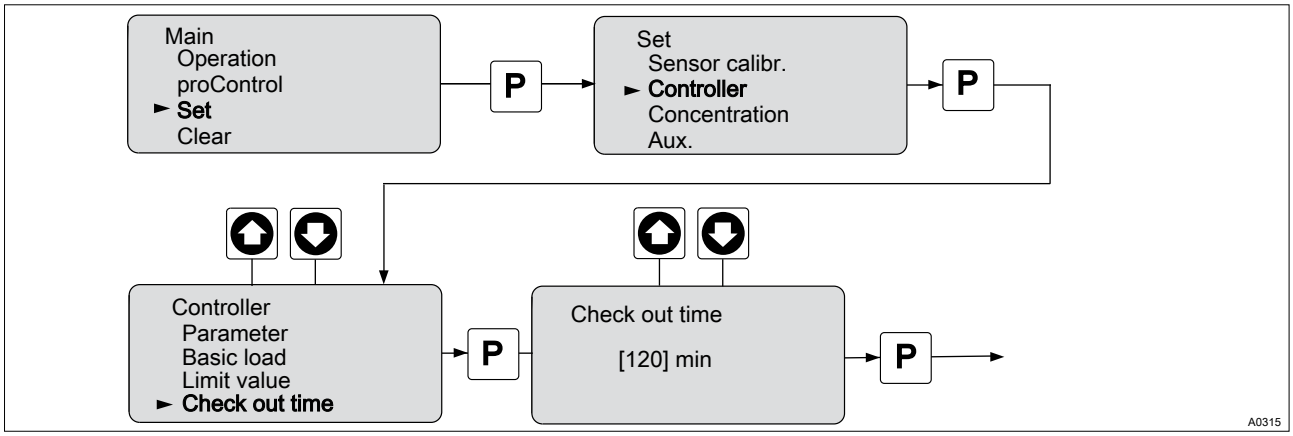

Fig. 19: Checkout time adjustment

Determining the dead time and setting the checkout time

Each control path has a dead time. The dead time is the time, which the control path requires to detect a change or addition of metered chemicals using its own instrumentation.

You must select the checkout time so that it is greater than the dead time. You can determine the dead time, by operating the metering pump in manual mode and, for example, metering acid.

NOTICE!

Dead time determination

You should only determine the dead time if the current process cannot be negatively influenced by manual metering.

You must determine the time, which the control path (i.e. the entirety of controllers, sensors, measurement water, in-line probe housings, etc.) requires to detect a first change in the measured value starting from the beginning of metering. This time is the *'dead time'*. A safety margin, e.g. 25%, must be added to this dead time. You must allocate an appropriate safety margin for your own particular process. If after the checkout time has elapsed, the setpoint is not reached, see *Chapter 5.8 'Setpoint adjustment' on page 27*, the metering pump switches to base load metering.

If the control module delta® has not reached the defined thresholds once the checkout time has elapsed, then the control module delta® switches over to base load operation. In the higher-level system, in this case the delta® solenoid metering pump, a warning is emitted and the symbol is output to the status display of the delta® solenoid metering pump.

In *[controlled pump]* operating mode, the symbol indicates that the required flow rate (setpoint) has not been reached. It may be that the set-point flow rate is too high or that the pump capacity is too low. However, the delta® solenoid metering pump does not switch to basic load on this fault message (in *[controlled pump]* operating mode), but continues to work in normal mode.

The threshold value equals 90 % of the setpoint. This value (90 % of the setpoint) must be achieved within the checkout time.

set-up	Comment
set-up	1 min to 999 min in 1 min steps
Starting value	Off = 0 min)

Resetting after activation of the checkout time

If the control module delta® is in *'checkout time'* mode, then base load metering is active. However it you want to return to normal control mode, then the control time must be restarted. To restart the control time, the key must be pressed.

5.10 Setting the delta® Control Module

"Controlled pump" operating mode

This setting menu does not exist in[controlled pump] operating mode. These control parameters are set in the factory in [controlled pump] operating mode.

The control path can be set in this menu. First, the feed chemical to be metered out must be selected, e.g. "increase" or "decrease".

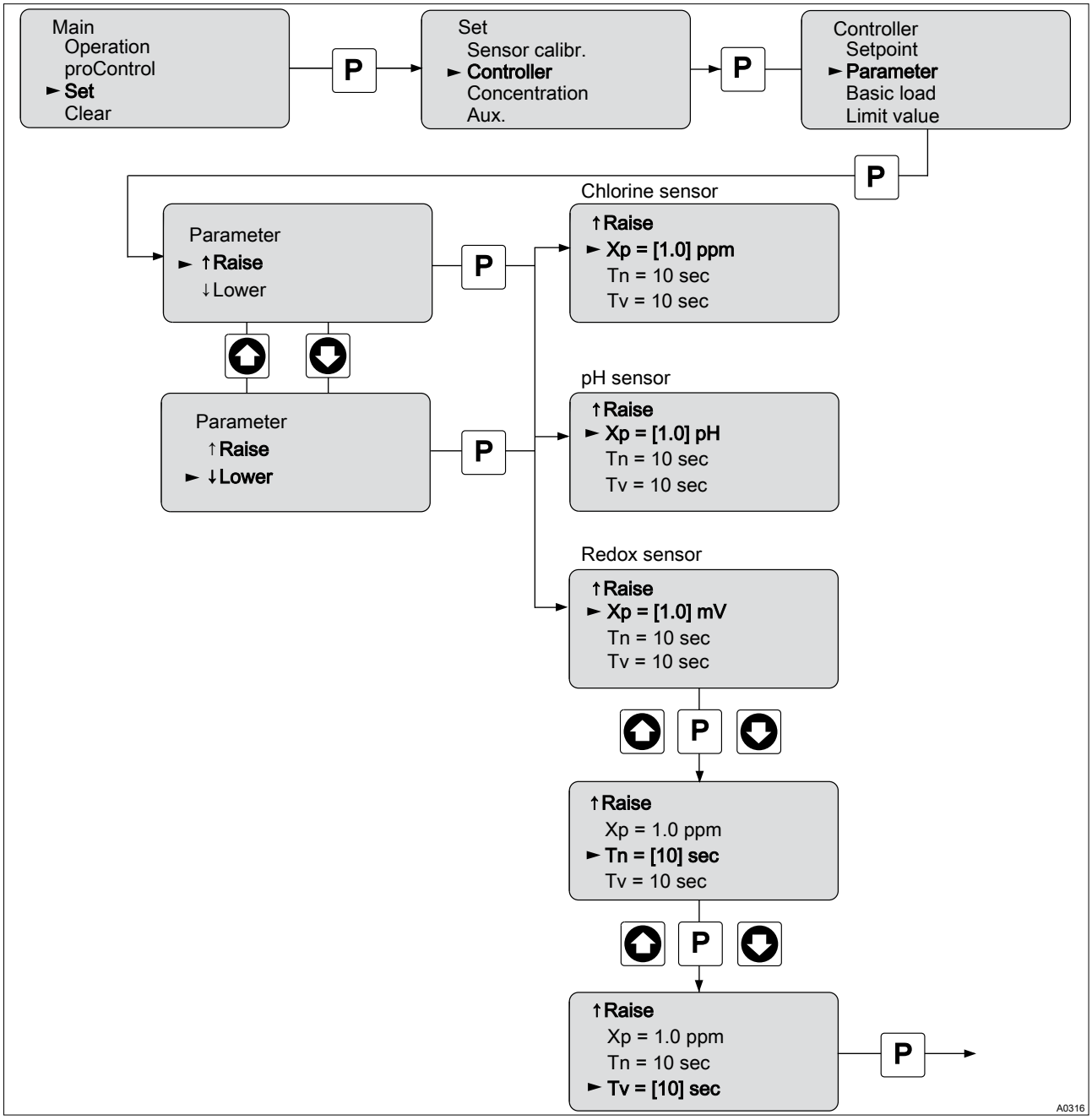

Fig. 20: Setting the control module delta®

The parameters for the control path can then be set. These are:

- X_p ➡ KP (reciprocal proportional coefficient)
- T_i ➡ is the reset time of the I-controller (integral controller) in seconds.
- T_v ➡ is the derivative action time of the D-controller in seconds.

T_i	T_d	Controller
0	0	P controller
>0	0	PI controller
0	>0	PD controller
>0	>0	PID controller

Sensor	Parameter	Comment
Chlorine	Setpoint	0.01 ppm to the upper limit of the measuring range. In steps of 0.01 ppm. Initial value: 50 % of the measuring range
	X_p	0 to measuring range in steps of 0.01 ppm. Initial value: 10 % of the measuring range
	T_i	0 s to 9999 s in steps of 1s. Initial value 0 s.
	T_d	0 s to 9999 s in steps of 1s. Initial value 0 s.
pH	Setpoint	pH 0.01 pH to 14 pH in steps of 0.01 pH. Initial value 50 % of measuring range
	X_p	0 pH to the measuring range in steps of 0.01 pH. Initial value: 10 % of the measuring range
	T_i	0 s to 9999 s in steps of 1s. Initial value 0 s.
	T_d	0 s to 9999 s in steps of 1s. Initial value 0 s.
Redox	Setpoint	0 mV to 1000 mV in steps of 1 mV. Initial value: 50 % of the measuring range
	X_p	0 mV to 1000 mV in steps of 1 mV. Initial value: 10 % of the measuring range
	T_i	0 s to 9999 s in steps of 1s. Initial value 0 s.
	T_d	0 s to 9999 s in steps of 1s. Initial value 0 s.

5.11 Factory Settings of the control module delta®

The factory settings that are loaded always refer to the currently used sensor (pH, redox, chlorine, flow or volume).

If the prompts is confirmed with *'yes'* then the default values are loaded for the characteristics data, measuring ranges, setpoints and control parameters.

Default values for the characteristics data

The parameters for the characteristic curves are default values. The sensors therefore have to be calibrated.

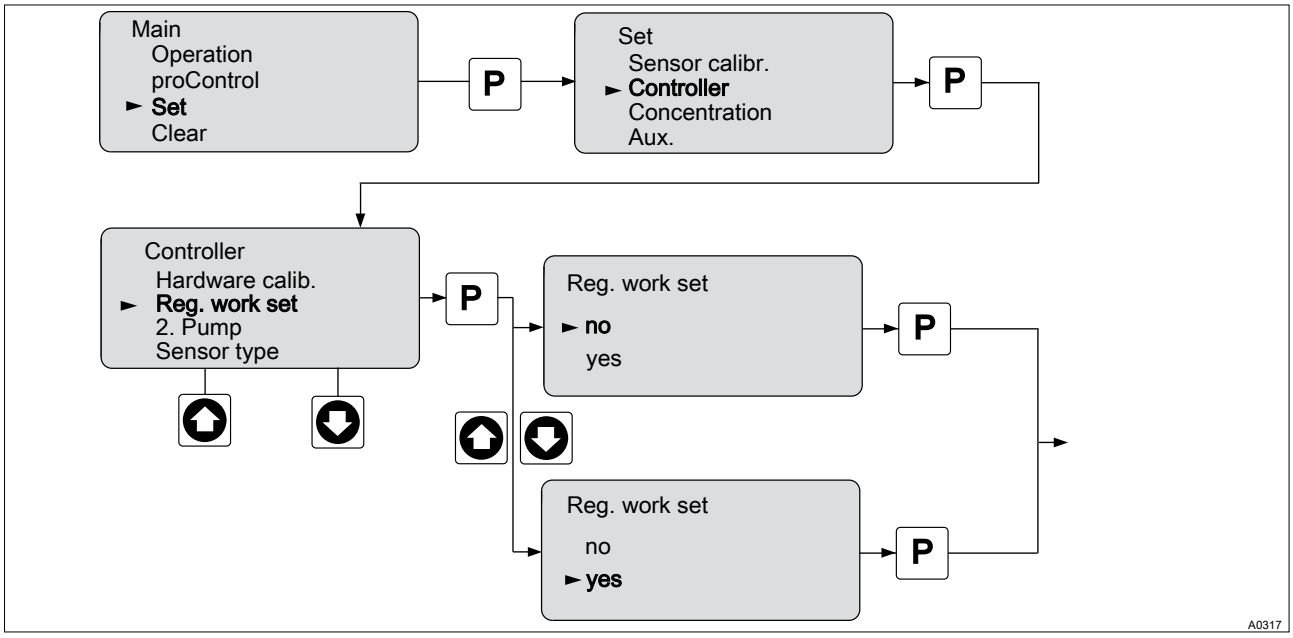

Fig. 21: Factory Settings of the control module delta®

Parameter	Value				Comment
	Chlorine	pH	Redox	Flow Volume	
Lower measuring range	0 ppm	0 pH	0 mV	0.01 l/h	
Upper measuring range	10 ppm	14 pH	1000 mV	80.00 l/h	
Setpoint	50 % of the measuring range			50.00 l/h	
Parameter X_p	10 % of the measuring range			Default	
Parameter T_i	0 s			Default	
Parameter T_d	0 s			Default	
Characteristic curve	Default			Default	Default parameter for the characteristic curve

5.12 Setting up "Two pump operation"

> ***"Controlled pump" operating mode***
> *This function is not supported in [controlled pump] operating mode.*

The control module delta® can also be operated in two pump operation. To do this different parameters can be entered for the second pump.

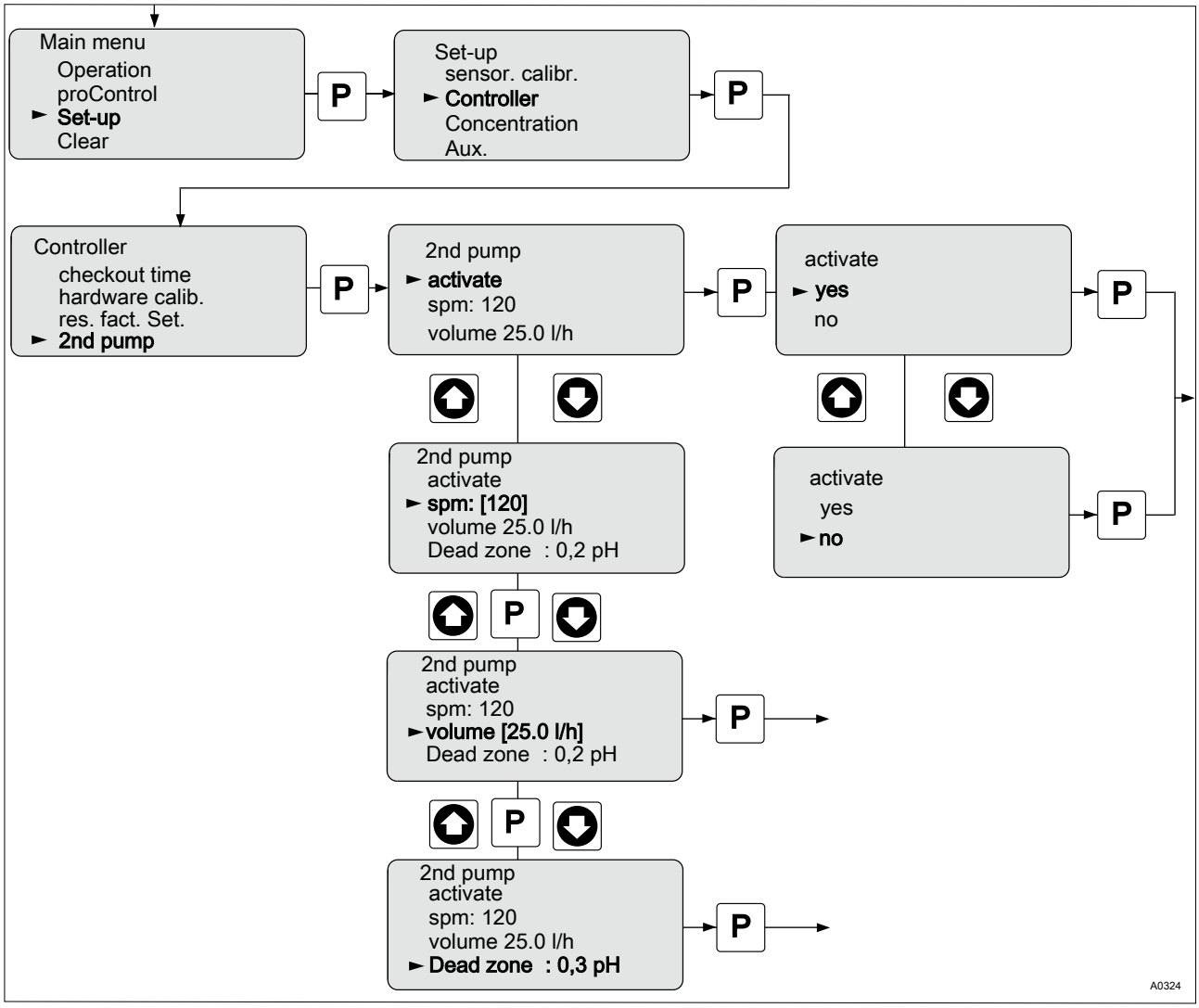

Fig. 22: Setting up "Two pump operation"

The control module delta® now directly controls the second pump via the relay output of the delta® solenoid metering pump.

set-up	Comment
Activate	The control is only active if the control relay in the delta® solenoid metering pump has been activated.
Strokes/min.	Pump stroke rate in strokes/minute. Maximum 180/min.
Volume	Volume in l/hour
Dead zone	During switching over of metering from pump 1 to pump 2 there is an interval during which no pump is metering. This interval is the dead zone.

5.12.1 Setting the controller pulse of the second pump

NOTICE!

Calibrating the delta® solenoid metering pump

To enable the second pump to be controlled by the delta ® solenoid metering pump, the delta® solenoid metering pump must have been calibrated. Notes for this purpose: Operating instructions "Solenoid metering pump delta® with controlled solenoid drive opto-Drive®", chapter *'Settings for the function "Calibration" (CALIBRATION menu)'*

Depending on the pump type that should be connected to the control relay of the delta® solenoid metering pump, it is necessary to set the controller pulse accordingly. The controller pulse can be a growing or a falling pulse of the controller relay. Take note that this menu can only be called up when a control relay has been installed in the delta® solenoid metering pump.

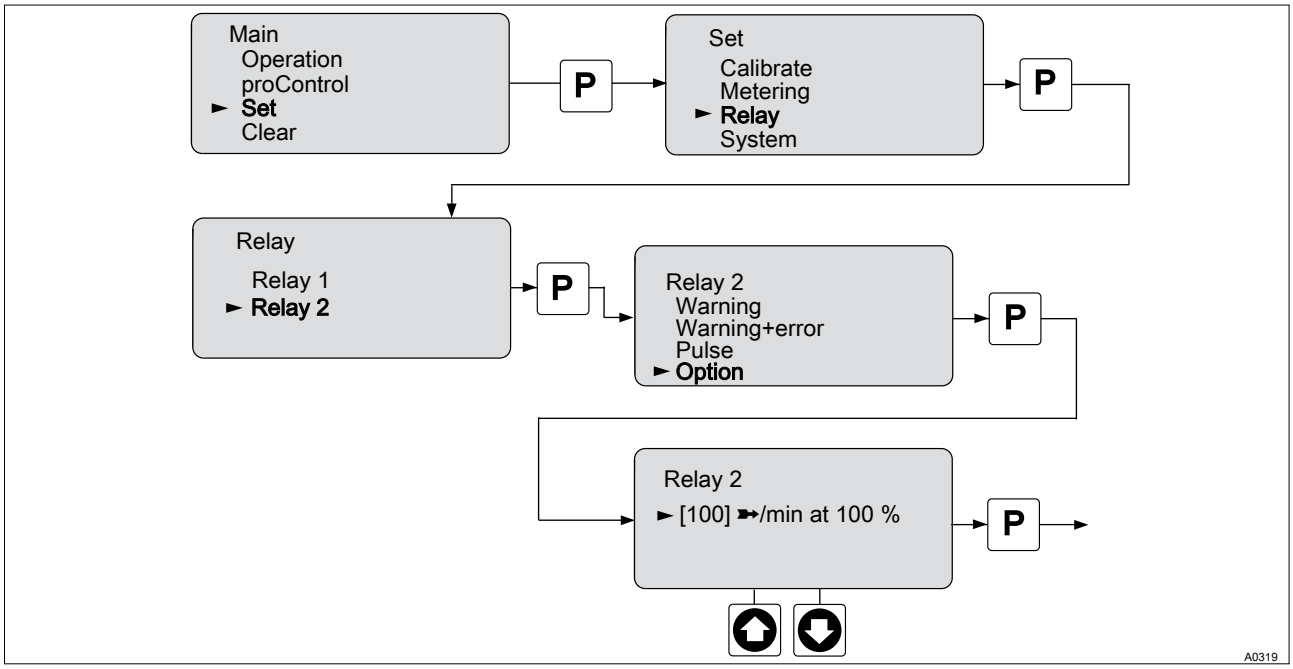

Fig. 23: Menu for adjusting the controller pulse of the second pump

5.13 Use of the current output of the delta®®

It is possible, using the current output of the delta® to output the current which is measured at the control module current input. To enable this function, the control relay with current output must be installed in the delta®.

Hence this menu can only be called in the display if a control relay with current output is installed in the delta®.

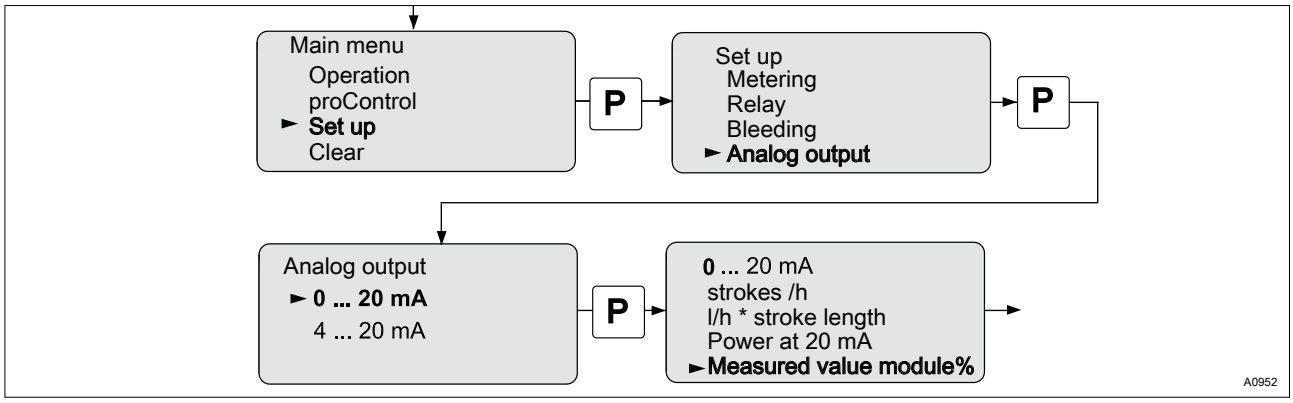

Fig. 24: Current output activation menu

5.14 Scaling the Output Value of the Analog Value

You can control the control module of the delta® with the analog module of the delta®.

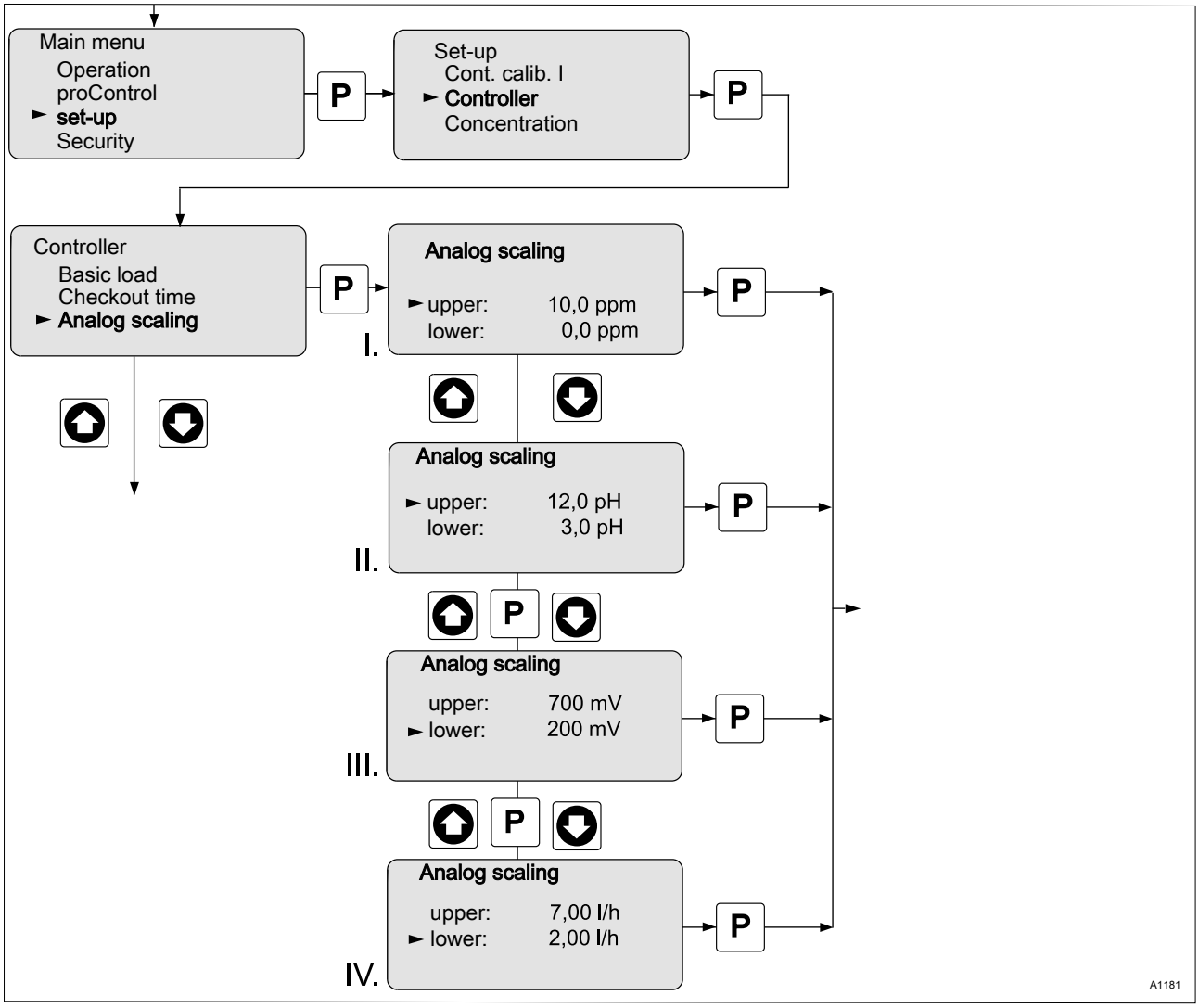

Fig. 25: Scaling the Output Value of the Analog Value

I. Chlorine sensor
II. pH sensor
III. ORP sensor
IV. DulcoFlow®

By scaling the output value of the analog value, you can assign the measured value to be output for a given current value (0 mA value= lower measured value / 20 mA value = upper measured value)

Scaling values can be set for each sensor type:

	Factory settings		
Sensor	**Lower value**	**Upper value**	**Adjustment range**
Chlorine	0 ppm	20 ppm	0 ppm to the maximum value of the sensor in steps of 0.1 ppm
pH	0,00 pH	14,00 pH	0 ... 14 pH in steps of 0.1 pH
mV	0 mV	1000 mV	0 ... 1000 mV in steps of 1 mV
DulcoFlow®	0.00 l/h	10 l/h	0.00 ... 80.00 l/h in steps of 10 ml/h

6 Measured variables control module delta®

WARNING!

Danger of incorrect metering

This can result in hazardous incorrect metering

During initial commissioning, the measured variable and the measuring range of the sensor must be set prior to calibration.

During all work on or with the sensors, also observe the relevant technical documentation of the sensors.

Sensor measuring range

You must match the controller measuring range to the measuring range of the chlorine sensor used.

Measured variable	Default measuring range
Chlorine	10 ppm
The measuring ranges can be continuously adjusted from 0.5 ... 20 ppm.	

pH Measured variable	Typical measuring range
Measuring range	0 ... 20 mA
Display range	At least pH -1.45 … 15.45
Reference temperature	+ 25 °C
Resolution	0,01 pH

Redox measured variable	Typical measuring range
Measuring range	0 mV ... + 1000 mV
Resolution	1 mV

DFMa measured variable	Typical measuring range

6.1 Calibrating the sensor for chlorine

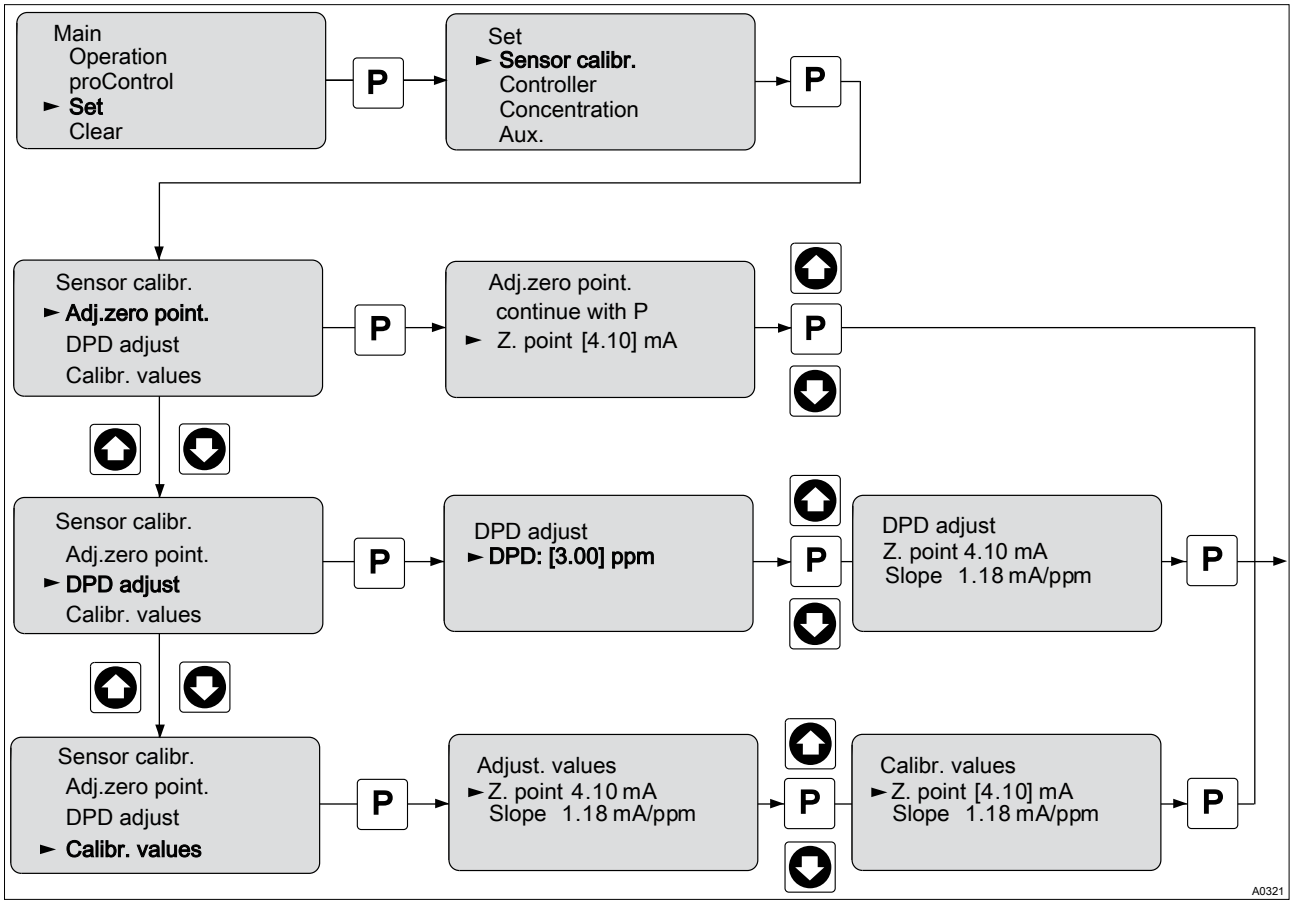

Fig. 26: Calibrating the sensor for chlorine

6.1.1 Preparing the calibration of the sensor for chlorine

CAUTION!

Correct sensor operation / Run-in time

Damage to the product or its surroundings

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating manual for the sensor
- Please also read the operating manuals for the fittings and other components used
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor

Necessity of calibrating the zero point

Calibration of the zero point is not generally necessary. Calibration of the zero point is only necessary if the sensor is operated at the lower limit of the measuring range or if the 0.5 ppm sensor version is used.

During the calibration, the control module delta® sets the actuating outputs to *'0'*. The mA standard signal outputs are frozen. The reading frozen at the start of calibration is suggested as a DPD value. The DPD value can be set using the arrow keys.

6.1.2 Calibration of Zero Point and Gradient

NOTICE!

Prerequisites for correct calibration of the sensor gradient

- The DPD method required by the metering medium employed will be used
- The run-in time for the sensor has been adhered to
- There is permitted and constant flow at the flow gauge
- There is temperature equalisation between the sensor and the sample water
- There is a constant pH value in the permitted range

Calibrating the chlorine sensor: slope

The sensor is fitted, flushed with sample water and connected electrically to the control module delta® and run-in.

There has to be adequate metering medium in the sample water for calibration (> 2% of the measuring range of the sensor).

Remove sample water directly at the measuring point and using an appropriate reference method (e.g. DPD, titration etc.), determine the content of metering medium in the sample water in *'ppm'*. Enter this value in the control module delta® as follows:

1. Select the calibration menu *[Sensor Calibration]*. The press the button P
2. Take a sample of water and perform a reference measurement immediately.
3. Select the unit *'DPD adjust'* to be calibrated using the buttons ⊖ or ⊕
4. The press the button P
   ⇨ The current reading will now be frozen.
5. When necessary, adapt the ppm value determined using keys ⊖ and ⊕
   ⇨ The ppm value of the sensor shown in this display now corresponds to the reading in *'ppm'*.
6. The press the button P
   ⇨ The display now shows the value determined for the zero point and gradient. Refer to the Error Message table should an error be displayed

Necessity of calibrating the zero point

Calibration of the zero point is not generally necessary. Calibration of the zero point is only necessary if the sensor is operated at the lower limit of the measuring range or if the 0.5 ppm sensor version is used.

Calibrating the chlorine sensor: Zero point

A container with water, which is free of additives that could falsify the measured result, is needed for calibration. Immerse the sensor removed that is still connected to the control module delta® electrically into this water. Stir the sensor around the water for approx. 5 minutes until the reading on the on the control module delta® is displayed steady and close to *'0'* .

1. Select the calibration menu *[Sensor Calibration]*. The press the button P
2. Select the unit *'Adj. zero point'* to be calibrated using the buttons ⇩ or ⇧
3. Continue with P
   ⇨ A prompt is shown in the display
4. Adapt the *' Zero point'* value displayed during the calibration using the buttons ⇩ or ⇧ and when necessary, accept the value using the button P
   ⇨ Refer to the Error Message table should an error be displayed

NOTICE!
Then definitively calibrate the gradient with a suitable reference method (e.g. DPD. titration etc.).

6.2 Sensor pH calibration

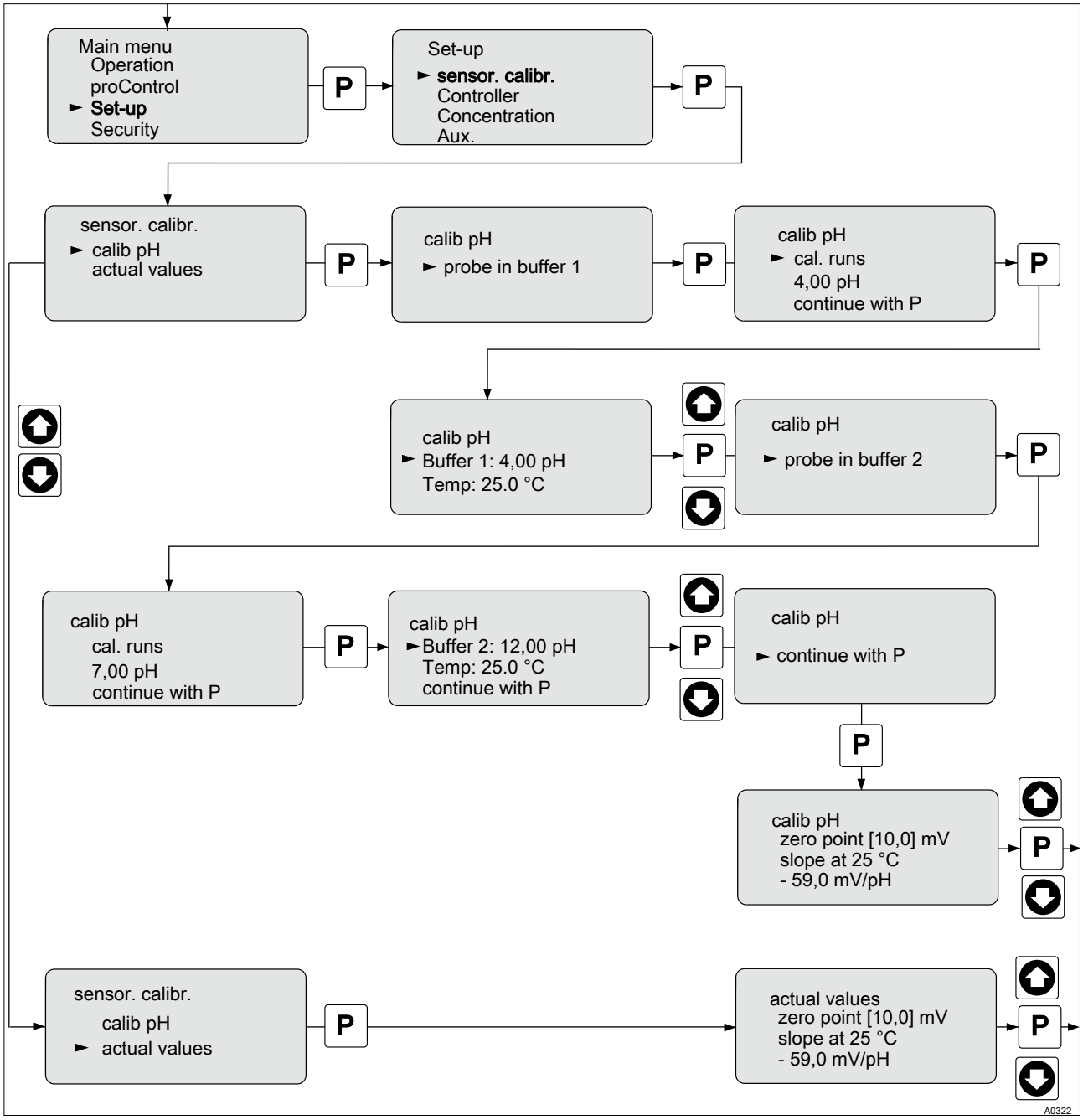

Fig. 27: Sensor pH calibration

6.3 Calibrating the sensor for Redox

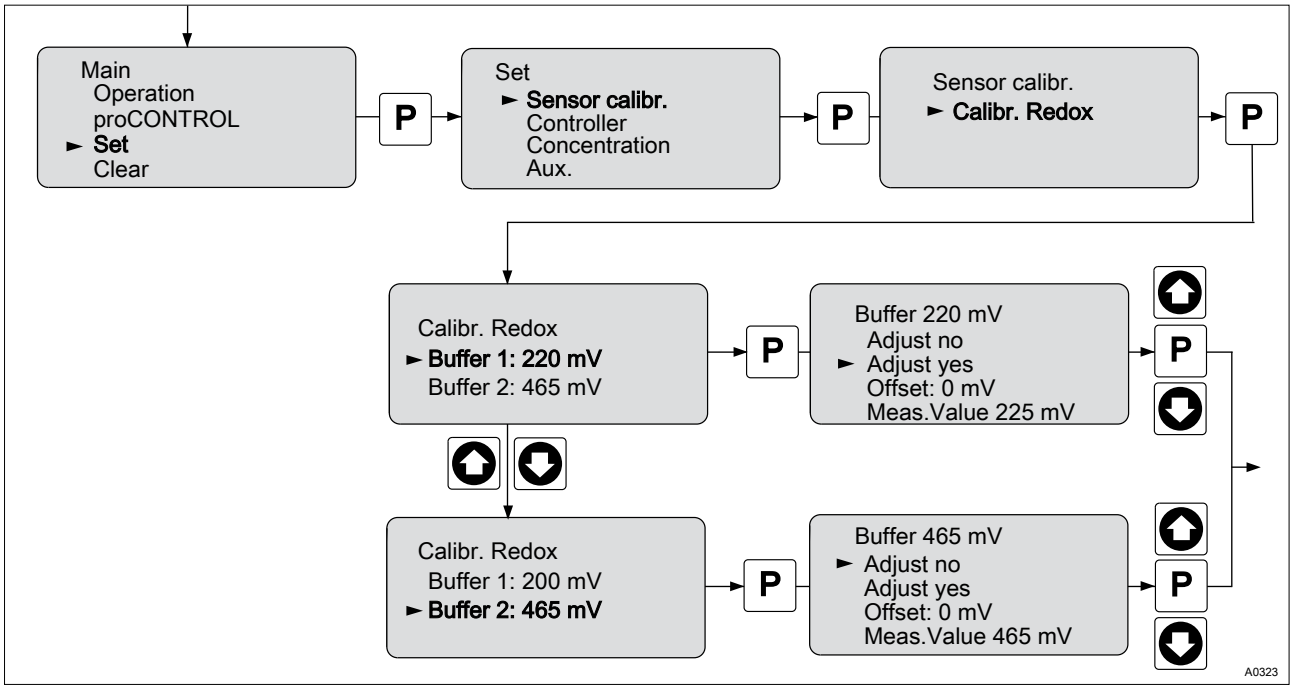

Fig. 28: Calibrating the sensor for Redox

7 Troubleshooting

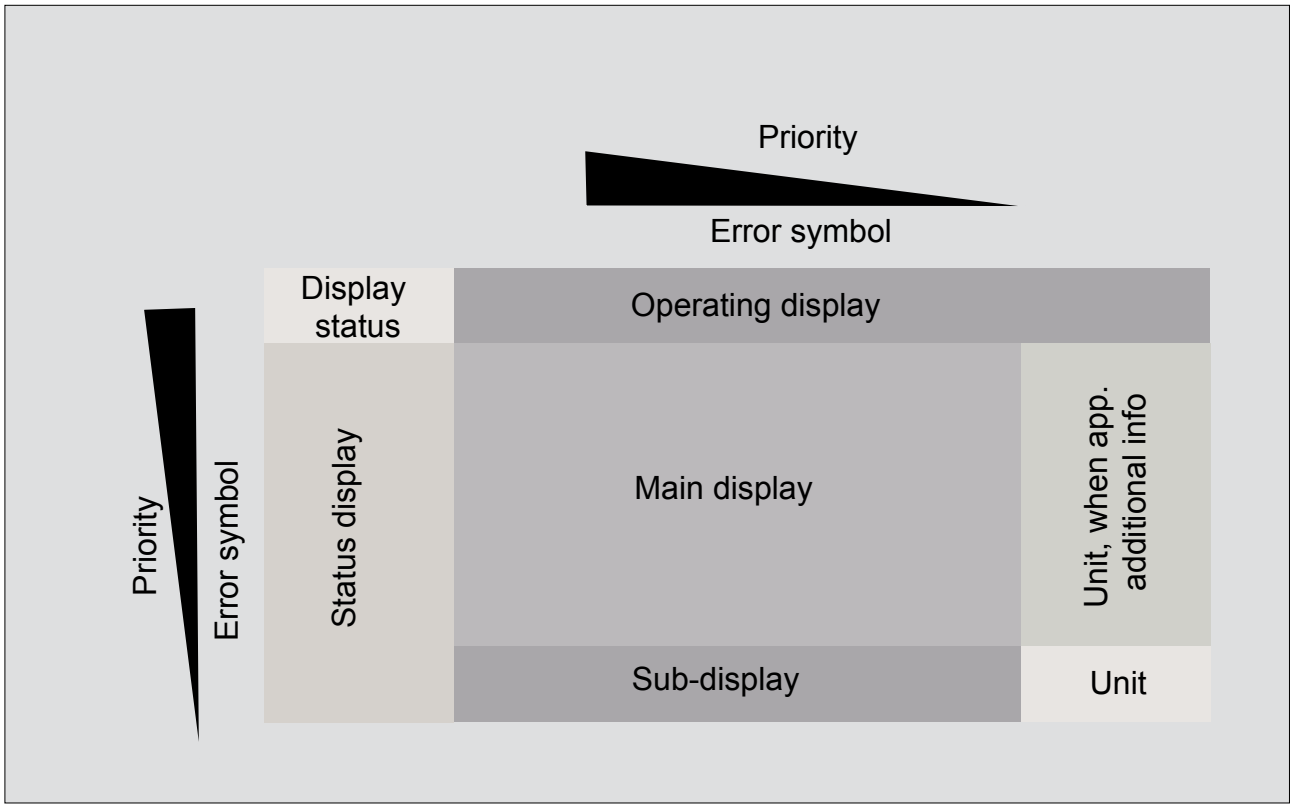

Fig. 29: Overview of the operating indicator of the delta® solenoid metering pump

	Operating indicator control module	Standard indicator in control mode. If the control module delta® is not activated, then the symbol is not displayed.

7.1 Fault Status Display

In the inactive state of the delta® control module, no fault or warning messages are transferred to the delta® solenoid metering pump.

The ⚡ symbol appears in the LCD display. The corresponding fault symbol flashes in the main display. If several faults are incoming then these are shown in order of their occurrence.

Image	Fault	Description
	Control module	A fault/error was detected in the control module delta® ■ EEProm fault ■ Data error ■ If the cal symbol is also displayed in the *'status display'* field, then a fault has been detected when calibrating the redox sensor (deviation from buffered value >+/- 40 mV)
i < 4 mA	Control module	A value less than 4 mA is measured at the current input.
i > 20 mA	Control module	A value greater than 20 mA is measured at the current input.
20 mA!	Control module	The 20 mA interface has been set to fault status ■ Short circuit ■ Overcurrent (> approx. 50 mA) ■ Countervoltage (< 0 V)
	Missing control module	Missing optional module or no communication established with the optional module If the optional "control module" was switched to active condition, then the delta® solenoid metering pump expects the control module delta® to register. This symbol is shown if it does not register
	DulcoFlow® error	This error symbol is displayed when: ■ The flow meter is not connected electrically to the control module. ■ There is a fault in the flow meter (e.g. air in the measuring head) ■ The flow meter is not in *'controlled pump'* operating mode

7.2 Error control module delta®

Error	Description
Hardware error	A hardware error has been detected ■ Access error to EEProm ■ Overcurrent / undercurrent sensor ■ Communication error
Software / data	Configuration values cannot be used, e.g. the control parameters (X_P, T_V, T_N) are all set to zero.

7.3 Warning Status Display

The display flashes The bottom line gives an explanation of the warning. In this condition the control module delta® is still operational.

Image	Warning	Description
	Control module	A warning from the control module delta®) has been detected ■ Feedforward control error (control module delta®) continues to work nevertheless) ■ Overflow of the control module output value (control module delta®) continues to work nevertheless) ■ A communication error between the pump ® and control module delta® has been detected. The connection LED illuminates in red.
	Checkout time	A warning from the control module delta®) has been detected ■ Checkout time elapsed (control module delta®) works in basic load)
	Limit	The limit has been exceeded/undershot ■ The delta® control module is in basic load control mode
	Calibration	A calibration error has been detected If an error has been detected, the calibration data are not adopted. Operation continues with the old calibration data. This relates to the calibration for the current interface and the sensors. If a warning is displayed during a sensor calibration, then this may refer to sensor error.
	DulcoFlow®	This warning is displayed when a fault that has previously occurred has now disappeared. This can happen, e.g. when gas bubbles have formed that have cleared themselves.

7.4 Warnings control module delta®

Warning	Description
Communication	A continuous communication error has been determined
Software / data	■ Configuration values are inconsistent ■ Communication error (unknown reply, wrong checksum)
Controllers	■ Limit value undershot / exceeded ■ Checkout time elapsed

7.5 LED status displays of the control module delta®

The LED status displays signal the current operating status of the control module delta®. There are different LED status displays: The devices LED and the Connection LED. The LED status displays do not have a flashing mode.

Devices LED

LED	Status
Green	Operating indicator
Red	Fault display ■ Internal hardware error ■ Sensor error
Orange	Warning indicator ■ Configuration error ■ limit value ■ Checkout time

Connection LED

LED	Status
-	Passive controller operation, otherwise OK
Green	Active control operation
Red	No connection to the pump Communication error

8 Technical Data, Maintenance, Disposal

Electrical data

Current input

	Value
Measuring range	0/4 mA - 25 mA (at 50 ohms measuring resistance)
Accuracy	After calibration, ± 0.5% of the upper range value at calibration temperature
Resolution	10-12 bit
Current input protected against pole reversal and feedback up to ± 30 V.	

Accuracy in controlled pump operation

	Value
Accuracy	± 3 % *
*** Accuracy of the control module 2 % + transmission path**	

Switchable voltage output

	Value
Output voltage	22.5 V-26 V load-dependent, < 50 ohms; maximum 50 mA
Output voltage protected against pole reversal and feedback up to ± 30 V.	

Electrical isolation to the delta® front panel board. Load current limited to approx. 55mA (51 mA - 58 mA).

In case of a short circuit (approx. 70 mA), switch off by foldback and by software. Reactivation by software.

Maintenance

The control module delta® is maintenance free.

Disposal of Used Parts

NOTICE!

Regulations governing disposal of used parts

– Note the current national regulations and legal standards which apply in your country

ProMinent Dosiertechnik, Heidelberg/Germany is prepared to take back decontaminated and clean used parts.

You can find the currently valid decontamination declaration for download under *www.prominent.com*.

9 Index